PROTOCOL

Human Health Constituents of Concern

Introduction

This protocol, developed in order to support the Savannah River Site environmental remediation program, provides instructions for the identification of *preliminary* Human Health Constituents of Concern (HH COCs). This protocol is applied after the human health risk calculations are performed.

Definitions

Carcinogens and Radionuclides:
ERR - Exposure Route Risk (ingestion, inhalation, dermal, etc.)
TMR - Total Media Risk
TCR - Total Cumulative Risk

Non-carcinogens:
ERHQ - Exposure Route Hazard Quotient
ERHI - Exposure Route Hazard Index (ingestion, inhalation, dermal, etc.)
TMHI - Total Media Hazard Index
TCHI - Total Cumulative Hazard Index
TOHI - Target Organ Hazard Index

Carcinogens

Perform the following steps for each human health risk assessment scenario considered in the document. Perform the steps separately for radionuclides and non-radionuclides.

1. For each *receptor/media/route* combination, perform a summation of the risk due to each constituent. This summed risk value is known as the ERR for that combination. (e.g. ERR_{ing} , ERR_{inh})

2. For each media, sum the ERRs. The sum of the ERRs is known as the TMR.

3. For each receptor, sum the TMRs from the nonradionuclide and radionuclide constituents to determine a single TCR value.

4. Within each media, apply the following definitions for carcinogens:

   Primary COC (COC *) - Constituents with an individual cancer risk greater than or equal to 1E-6 and in an exposure media with a TMR greater than or equal to 1E-4.

   Secondary COC (COC**) - Constituents with an individual cancer risk greater than or equal to 1E-6 and in an exposure media with a TMR greater than or equal to 1E-6.

Non-carcinogens

Perform the following steps for each human health risk assessment scenario considered in the document.

1. For each *receptor/media/route* combination, perform a summation of the exposure route hazard quotients (ERHQs) for each constituent. This summed value is known as the ERHI for that combination. (e.g. $ERHI_{ing}$, $ERHI_{inh}$)

2. For each media, sum the ERHIs. The sum of the ERHIs is known as the TMHI.

3. For each receptor, sum the TMHIs. The sum of the TMHIs is known as the TCHI.

4. If the TMHIs are greater than or equal to 1, segregate the constituents based on relevant target organs. Sum the ERHQs according to target organs. This value is known as the TOHI.

5. Apply the following definitions for hazardous constituents:

   Primary COC (COC *) - Constituents with an ERHQ greater than or equal to 0.1 and in an exposure media with a TOHI greater than or equal to 3.

   Secondary COC (COC**) - Constituents with an ERHQ greater than or equal to 0.1 and in an exposure media with a TOHI greater than or equal to 1 but less than 3.

Example I: Determination of Cancer Risk-Based Primary and Secondary COCs

Industrial Worker Scenario

		EXPOSURE ROUTES						Totals
MEDIA	CONSTITUENT	INGESTION	COC	INHALATION	COC	DERMAL	COC	
Soil (0-1')	A	2.00E-04	COC*	1.00E-08		5.00E-07		
	B	1.00E-07		8.00E-08		1.00E-08		
	C	1.00E-06	COC*	2.00E-06	COC*	2.00E-06	COC*	
		2.01E-04 ERR_{ing}		2.09E-06 ERR_{inh}		2.51E-06 ERR_{derm}		2.06E-04 $TMR_{soils(0-1')}$
Groundwater	A	1.00E-05	COC**					
	B	1.00E-07						
	C	1.00E-06	COC**					
		1.11E-05 ERR_{ing}						1.11E-05 TMR_{gw}

$TCR_{industrial\ worker}$ = 2.17E-04

Total Media Risk (TMR) = $ERR_{ing} + ERR_{inh} + ERR_{derm}$
Total Cumulative Risk (TCR) = $TMR_{soils\ (0-1')} + TMR_{gw}$

COC* = primary COC
COC** = secondary COC

Example II: Determination of Hazard-Based Primary and Secondary COCs

Industrial Worker Scenario

Step A: Determine TMHI and TCHI

			EXPOSURE ROUTES			Totals	
MEDIA	**CONSTITUENT**	**Target Organ**	**INGESTION**	**INHALATION**	**DERMAL**		
Soil (0-1')	A	kidney	2.00	0.57	0.20		
	B	kidney	0.50	0.15	0.30		
	C	skin	0.07	0.02	1.00		
			2.57	0.74	1.50	4.81	
			$ERHI_{ing}$	$ERHI_{inh}$	$ERHI_{derm}$	$TMHI_{soils(0-1')}$	**TMHI ≥ 1**
Groundwater	A	kidney	0.45				
	B	kidney	0.30				
	C	skin	0.01				
			0.76			0.76	
			$ERHQ_{ing}$			$TMHI_{gw}$	**TMHI< 1**

$TCHI_{industrial\ worker}$ = 5.57

If TMHI is ≥ 1, segregate constituents based on target organ.

Total Media Hazard Index (TMHI) = $ERHI_{ing} + ERHI_{inh} + ERHI_{derm}$

Total Cumulative Hazard Index (TCHI) = $TMHI_{soils\ (0-1')} + TMHI_{gw}$

Example II: Determination of Hazard-Based Primary and Secondary COCs (continued)

Step B: Separate by Target Organ

Target Organ: Kidney

		EXPOSURE ROUTES						Totals
MEDIA	**CONSTITUENT**	**INGESTION**	**COC**	**INHALATION**	**COC**	**DERMAL**	**COC**	
Soil (0-1')	A	2.00	COC*	0.57	COC*	0.20	COC*	
	B	0.50	COC*	0.15	COC*	0.30	COC*	
		2.50		0.72		0.50		3.72
		$ERHI_{ing}$		$ERHI_{inh}$		$ERHI_{derm}$		$TOHI_{kidney}$

Target Organ: Skin

		EXPOSURE ROUTES						Totals
MEDIA	**CONSTITUENT**	**INGESTION**	**COC**	**INHALATION**	**COC**	**DERMAL**	**COC**	
Soil (0-1')	C	0.07		0.02		1.00	COC**	
		0.07		0.02		1.00		1.09
		$ERHI_{ing}$		$ERHI_{inh}$		$ERHI_{derm}$		$TOHI_{skin}$

Total Organ Hazard Index (TOHI) = $ERHI_{ing} + ERHI_{inh} + ERHI_{derm}$

COC* = primary COC
COC** = secondary COC